Small Business Innovation Research/Small Business Tech Transfer

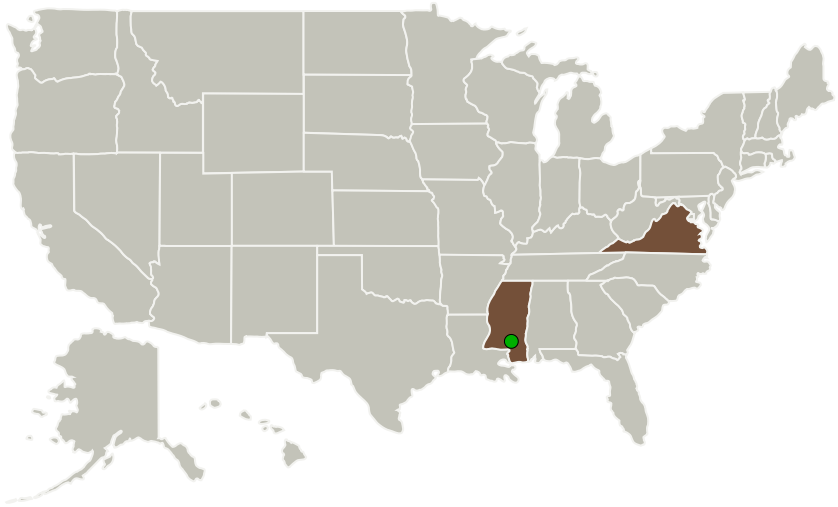
High Figure-of-Merit Macro-Structured Thermoelectric Materials, Phase I

Completed Technology Project (2015 - 2016)

Project Introduction

Thermoelectric devices are critical to multiple NASA missions for power conversion with radioisotope sources. At present, commercially available TE devices typically offer limited heat-to-electricity conversion efficiencies, well below the fundamental thermodynamic limit, calling for the development of higher efficiency materials. The team of MicroXact Inc. and Virginia Tech is proposing to develop a revolutionary high efficiency thermoelectric material fabricated on completely new fabrication principles. The proposed material and device will provide NASA with much needed highly efficient (ZT>1.6), macroscopically thick (from 100s of micrometers to over a millimeter) thermoelectric material that will permit >15% conversion efficiency of thermoelectric generation when using high grade space-qualified sources. The proposed material is comprised of PbTe/PbSe three-dimensional "wells" of PbTe/PbSe quantum dot superlattices (QDS) fabricated by a conformal coating of a structured silicon substrate with electrochemical Atomic Layer Deposition (eALD). In Phase I of the project the feasibility of the approach will be demonstrated by proving ZT>1.6. In Phase II the team will fabricate the thermoelectric generator, and will demonstrate conversion efficiencies exceeding 15%. After Phase II, MicroXact will commercialize the technology.

Primary U.S. Work Locations and Key Partners



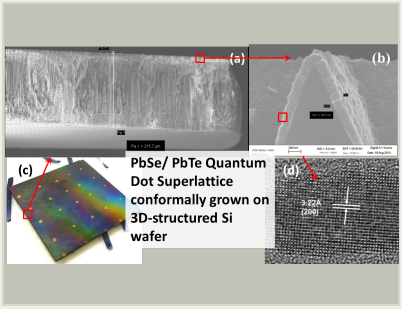


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Table of Contents

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Organizations Performing Work	Role	Type	Location
MicroXact, Inc.	Lead Organization	Industry	Radford, Virginia
Stennis Space Center(SSC)	Supporting Organization	NASA Center	Stennis Space Center, Mississippi
Virginia Polytechnic Institute and State University(VA Tech)	Supporting Organization	Academia	Blacksburg, Virginia

Primary U.S. Work Locations	
Mississippi	Virginia

Project Transitions

June 2015: Project Start

June 2016: Closed out

Closeout Summary: High figure-of-merit macro-structured thermoelectric mat erials, Phase I Project Image

Closeout Documentation:

- Final Summary Chart Image*(https://techport.nasa.gov/file/139048)*

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

MicroXact, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

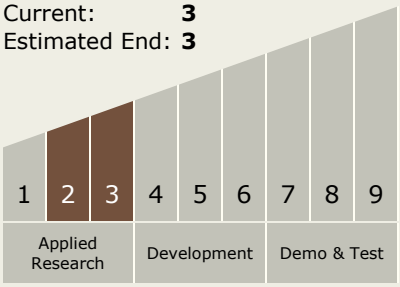
Carlos Torrez

Principal Investigator:

Vladimir Kochergin

Technology Maturity (TRL)

Start: **2**
Current: **3**
Estimated End: **3**



High Figure-of-Merit Macro-Structured Thermoelectric Materials, Phase I

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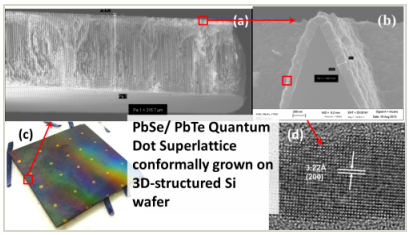
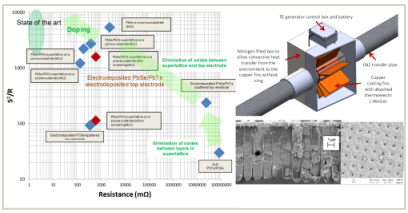
Images



Briefing Chart Image
High figure-of-merit macro-structured thermoelectric materials, Phase I
(https://techport.nasa.gov/image/133553)



Final Summary Chart Image
High figure-of-merit macro-structured thermoelectric materials, Phase I Project Image
(https://techport.nasa.gov/image/126984)

Technology Areas

Primary:

- TX03 Aerospace Power and Energy Storage
  - TX03.1 Power Generation and Energy Conversion
    - TX03.1.4 Dynamic Energy Conversion

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System